International Telecommunication Union

QUESTION 6-2/1

Final Report

ITU-D STUDY GROUP 1 4th STUDY PERIOD (2006-2010)

QUESTION 6-2/1:

Regulatory impact of next generation networks on interconnection

THE STUDY GROUPS OF ITU-D

In accordance with Resolution 2 (Doha, 2006), WTDC-06 maintained two study groups and determined the Questions to be studied by them. The working procedures to be followed by the study groups are defined in Resolution 1 (Doha, 2006) adopted by WTDC-06. For the period 2006-2010, Study Group 1 was entrusted with the study of nine Questions in the field of telecommunication development strategies and policies. Study Group 2 was entrusted with the study of ten Questions in the field of development and management of telecommunication services and networks and ICT applications.

For further information

Please contact:

Mr. Makhtar FALL
Telecommunication Development Bureau (BDT)
ITU
Place des Nations
CH-1211 GENEVA 20
Switzerland
Telephone: +41 22 730 6256
Fax: +41 22 730 5484
E-mail: makhtar.fall@itu.int

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Regulatory impact of next generation networks on interconnection

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This report has been prepared by many experts from different administrations and companies. The mention of specific companies or products does not imply any endorsement or recommendation by ITU.

ABSTRACT

The document contains the Draft Report on Question 6-2/1. The report contains a brief discussion on the main issues and potential challenges to NGN interconnection. All participants are requested to send their valuable comments as early as possible.

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QUESTION 6-2/1

Introduction

During the first meeting of ITU-D Study Group 1 held in Geneva in September 2006 the Rapporteur's Group agreed to look at the issues arising from the interconnection of Next-Generation Networks. It was also agreed that a report at least identifying the issues of interconnection in next generation network would be completed by the end of study period and that participants would work together through electronic mail. The report will identify issues and potential challenges to NGN interconnection. In the second meeting during September 2007, it was further decided to send a call for contributions to Member States and Sector Members in order to collect appropriate information on the topics to be covered in the study of the Question. Contributions have been sought in particular from ITU Administrations and ITU-D Sector Members. Unfortunately, the call for contribution did not receive many responses. The Rapporteur's group meeting on 23-24 April 2008 took note of the fact that there are very few contributions. This could mean that the Question of NGN interconnection has been posed too early and this situation could continue for some time because NGN are not yet widely deployed and the issue of NGN is new in ITU. Technically, things are going faster than on the regulatory side. NGN today is dividing the historical operators into three operators: 1) the service provider; 2) the operator for the transmission of the packets and 3) the operator for the management of the NGN system, responsible for quality of service and accounting issues. NGNs are supposed to provide all kinds of information and communication technology (ICT) and telecommunications services anywhere at any time at the best possible price. At present, the only country which has started to implement NGN networks on a large scale is the United Kingdom. NGN covers both wired and wireless telecommunications, but it is broadband and uses soft switches. ITU-T Study Group 3 managed to have the first recommendation on accounting rates on NGN. On the basis of contributions and discussions held during various meeting, this report identifies the major issues and potential challenges to NGN interconnection. During the last meeting of Rapporteur's group, it emerged that the Question had been posed too early vis-à-vis the extensive deployment of NGN networks. It was decided to maintain the Question in a revised form. We are still in an early phase of NGN deployment and there exist more questions than answers to many of the regulatory challenges presented. This report highlight the main concern that regulators and policy makes should begin to address when dealing with NGN.

1. Interconnection architecture

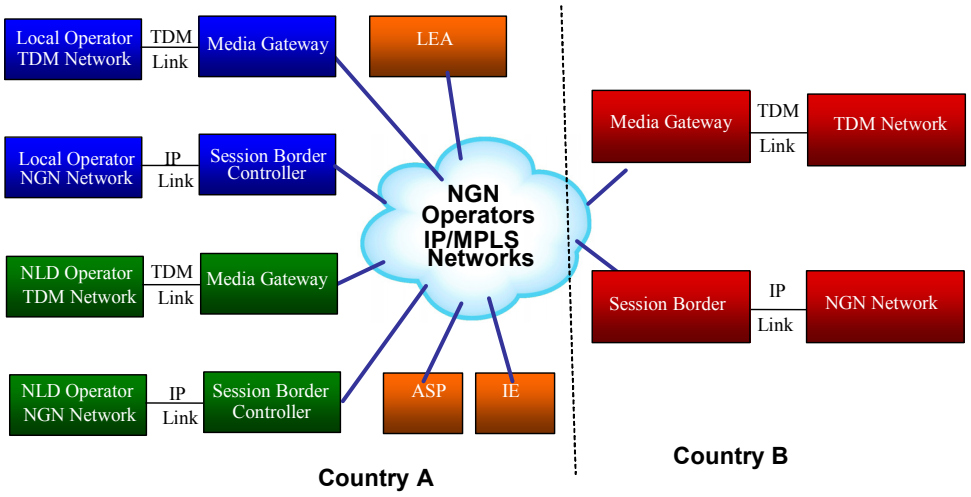
Many of the networks created over the last few years contain most of the elements of the NGN. Advances approaches to interconnection have been slow to deploy, even where the technology has been mature or within the hailing distance of maturity. Due to efficiency and flexibility of IP technology, most new networks being established are IP based. Some basics of the network architecture has been covered in Document ITU-D 2/190 (Report of Question 19-1/2). The green field operators who have deployed network recently are already going for all IP network.

For example : Warid Telecom International Ltd , the green field operator in Bangladesh has deployed all IP network in view of faster network deployment, reduction in CAPEX,reduction in OPEX. The presentation given by Warid Telecom International Ltd in SATRC Workshop on Regulatory Aspects of NGN including Interconnection held in New Delhi (16-17 Oct 2008) is annexed as Annex 1.

The inter-operator scenario in the NGN environment is shown in figure 1.

Peering with traditional PSTN and mobile networks based on the ISDN User Protocol (ISUP) may be interconnected via the Media Gateway for IP to TDM or TDM to IP conversion and the Signaling Gateway for SS7 transport over IP.

Figure 1: Interconnection architecture of inter-operator environment in NGN scenario



LEA: Law Enforcement Agency
ASP: Application Service Providers

As shown in figure 1, NGN networks are interconnected by Session Border Controllers (SBCs), which are located at the administrative boundary of a network for enforcing policy on multimedia sessions. A session policy may be defined to manage security, service level agreements, network device resources, network bandwidth, inter-working and protocol interoperability between networks.

SBCs can perform a number of functions such as:

- Network Security
- Denial of Service attacks and overload control
- Network Address Translation and Firewall Traversal
- Lawful Interception
- Quality of Service (QoS) management
- Protocol Translation
- Call accounting

The MGW (Media Gateway) shown in Figure 1 will be controlled by a soft switch deployed by the PSTN/mobile operators in NGN. A SGW (Signalling Gateway) can be integrated into the MGW or can also be a stand-alone device. To help migration of legacy networks to NGN at least voice based services, NGN provides two capabilities. These capabilities are discussed in Document ITU-D 2/190 (Report of Question 19-1/2).

2. Interfaces

2.1 Physical interfaces

The Session Border Controller SBC provides IP interface(s) towards other NGN networks. The physical interfaces consist of:

Gigabit Ethernet interfaces.

10/100 Base-T Fast Ethernet interface(s).

SBC provides redundant signaling and media control sub-systems, each with redundant network interfaces. Sub-systems of the SBC communicate to one another over any of the available IP interfaces.

2.2 Signaling interfaces

The network model for which the signaling interfaces have been defined is assumed to be an all IP next-generation network (NGN) where the control point in the network could be the:

- Soft switch or
- IMS (IP Multi-media Service) core

Standardization of signaling is mainly the role of ITU-T and therefore does not fall within the scope of this question. However, regulatory issues arising from the adoption of particular types of interfaces are important. While ITU-T standardizes protocols and signaling, this question should address whether regulators should mandate a given standard to ensure interoperability or leave this to operators, risking lack of interoperability.

ITU-T study group 13 has already forwarded draft recommendations in response to the liaison statement for this question. ITU-T recommendations Y.2701 and Y.2201 provide security requirements for interfaces and high level requirements for services and capabilities for next-generation networks. In addition to these recommendations there are a series of NGN release documents, from NGN focus groups related to definition, protocols and architecture.

ITU-T has also approved a signaling recommendation Q.3401, NGN Signaling profile, which regulators may wish to use.

3. Points of Interconnection

During the transition phase, dominant operator may be obliged to maintain traditional PSTN interconnection capabilities. Assuming that it is possible for competitors to reach dominant's NGN-based end-user customers through traditional interconnection, there may not necessarily be a regulatory obligation to provide new NGN-based interconnection capabilities. Dominant operator will offer IP-based interconnection at some point during the transition phase. As the transition phase draws to a close, they may like to withdraw traditional interconnection. To the extent that they still possess market power, they should almost certainly be under regulatory obligations to provide interconnection to the NGN at cost-based prices. In the world of the Internet, the great majority of interconnection takes the form either of peering or of transit. In case of NGN market participants may prefer peering, transit, or some other model of interconnection. In fact, peering offers exchange of traffic only between dominant customers and those of its peer, but does not provide either with access to third parties. In a typical transit relationship, by contrast, the transit customer can use the transit provider's network to reach destinations anywhere on the Internet. Dominant service provider is unlikely to be motivated to offer peering arrangements to tiny competitive operators. It might offer peering arrangements to just a few of its largest domestic competitors. At that point, small domestic competitors have limited options either they might stick with PSTN interconnect or they may purchase transit service from one of the dominant operator. A plethora of problems stand in the way of implementing a robust interconnection framework for IP based NGN and of successfully operating such a frame work to emerge. Establishing and maintaining an interconnecting arrangement with another firm takes work. The technical effort sometimes is essential, depending upon circumstances. What are often overlooked are administrative and contractual costs of establishing IP interconnection arrangements. One of the possibilities may be explored to set up an IP based Interconnect exchange which may transit all IP traffic of all operators in default if there is no peering arrangement between the operators.

3.1 Interconnect Exchange (IE)

The basic concept of the Interconnect Exchange is to enable different operators to interconnect to a common point, to exchange mutual traffic efficiently. Internet Exchanges may be one option regulators may wish to consider as a model appropriate for NGN interconnection.

The role of Interconnect Exchanges

- Inter-Carrier Billing

Presently inter-carrier billing is a major issue of dispute between various service providers and is likely to escalate unless corrective steps are put in place. Using an interconnect exchange also as an inter-carrier billing clearing house may provide a solution to this major challenge. Inter-operator charging could be a function of a) grade of service, b) content, and c) network elements used while carrying traffic to the Interconnect exchange.

- Intelligent Network Services

Intelligent Network Services in a multi-operator multi-service scenario could be provided through the combination of the Interconnect Exchange/Inter-Carrier Billing Clearing House.

- Number Portability

Number Portability could also be addressed for a multi-operator multi-service scenario through a centralised database available to the Interconnect Exchange/Inter-Carrier Billing Clearing House

- Simplification

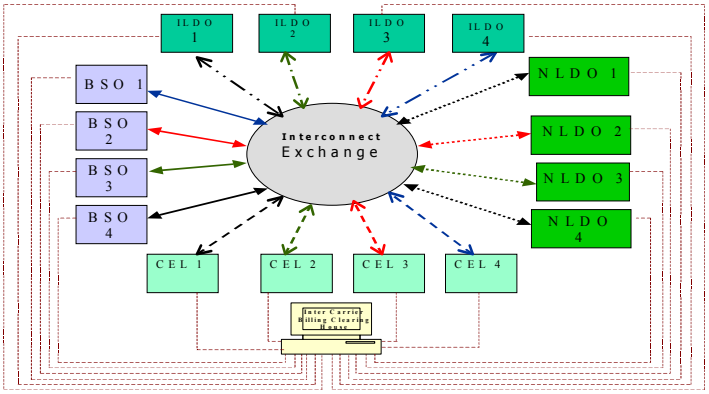
Use of an Interconnect Exchange/Inter-Carrier Billing Clearing House could also lead to simplified network architecture, a reduction in the number of Points of Interconnection (POI), simplification in settlement of interconnect usage charges as well as shorter waiting periods for interconnection capacity.

Challenges posed by current interconnection regimes

Current bilateral interconnection arrangements in a multi-operator, multi-service environment can lead to:

- High interconnection cost and port charges
- Asymmetric interconnection agreements and litigation due to ambiguities and a non-level playing field.
- Delays in provisioning of interconnection due to capacity constraints
- Sub-optimal utilization of resources
- Inefficient handling of calls
- High operational costs for managing inter-operator settlements
- Inter carrier billing
- Complexity in settlement of interconnect usage charges
- Sharing of Intelligent Network Platform
- Implementation of Number Portability
- Increase of CAPEX and OPEX making operation unviable

Figure 2: Interconnect Exchange



Note: BSO means Basic service providers/fixed line service provider
CEL means mobile network

3.2 Location of points of interconnection

Currently operators peer among themselves at mutually agreed POIs. At areas where the operators are unable to peer among themselves, the network of other operators is used for transit.

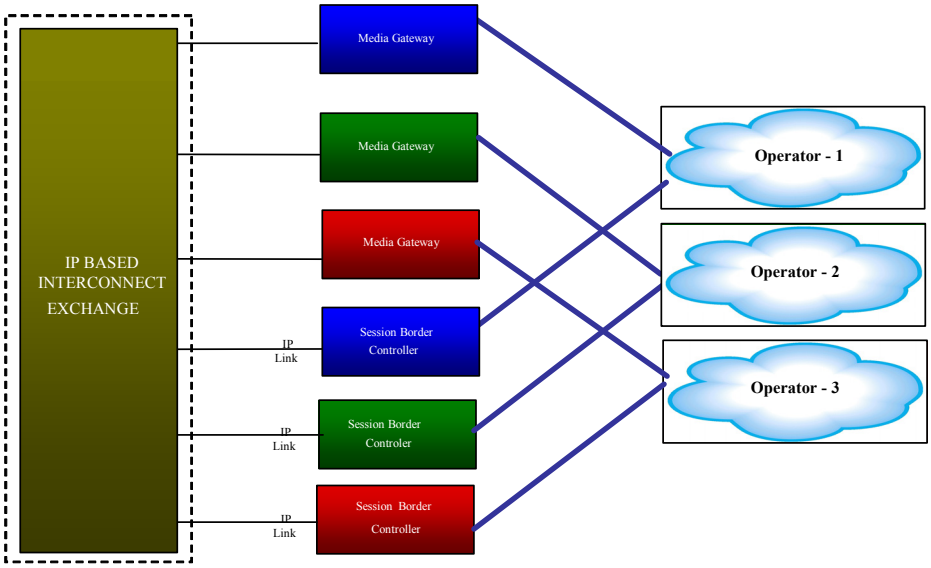
At present, both peering partners must have TDM based switches at the POI locations. With implementation of MPLS networks, the concept of cost of carriage with respect to distance loses its relevance. NGN with its separation of control and media functions and distributed architecture eliminates this restriction. The following methodology is proposed for the NGN environment.

i) The operators may be allowed to have the option of either a centralized control point in its network controlling the distributed media gateways or SBCs within the service area.

ii) The operator should be allowed to place media gateways and/or SBCs anywhere in the country, wherever POIs are desired.

iii) An Interconnect Exchange is proposed for interconnection between different operators in the NGN environment as shown in Figure 3.

Figure 3: Interconnect Exchange Model



One or more Interconnect Exchanges can be established at service area level depending on the traffic requirements, at the locations where most of the operators have a presence.

The advantage of this model is that it makes network planning more efficient. Every operator is aware of the physical location at which it would have to provide the POI enabling transmission network roll-out in a more planned way.

The architecture for Interconnection in NGN should be comparable or more rugged than the current PSTN/ISDN/mobile network service since NGN is expected to replace these networks over time. Consequently, one of the key objectives of the architecture would be to have service restored with minimum downtime in case of failure of interconnection. It implies that a resilient multiple node architecture has to be used along with IP protocols and networking technologies specially configured to meet the stringent requirement.

The interconnection in an NGN environment should operate at two logical layers – the signaling layer and the Media layer. In order to minimize the cost and complexity in the interconnection, L2 connectivity may be preferred over L3 interconnects with Logical VLANs/VPNs (virtual local area networks/virtual private networks).

Interconnection in an NGN environment would provide a secure, low latency environment in which the quality of wholesale interconnects is guaranteed between all operators.

4. Interconnection Charges

The current concept of interconnection charges in the PSTN/mobile network environment is based on distance and the time/duration of a call. In the world of the IP-based NGN, the network provider will still in most cases still be a service provider, but it will not necessarily be the only service provider Vonage, Skype and SIPgate are examples of competitive firms that provide services without operating a network of their own. For the foreseeable future, integrated and independent service providers are likely to coexist, and to compete for the same end-users customers. This separation of function has profound implications for both the network provider and the service provider. In theory, the network provider in an IP-based world does not

know or care about the nature of the application traffic that it is carrying – and in this context, voice is just another application.

In the NGN scenario interconnection charges could adopt a variety of models, including the Bill & Keep model, or, where charges are used, they could be based on bandwidth and application usage, quality of service provided, the number of network elements used, the volume of data exchanged during a session, time-of-day, etc.

NGN Networks may require many more features for charging as given below:

- Charging based on call duration, bearer capability, time and type of day etc.
- Charging based on QoS, bandwidth, application etc.
- Chargeable party (calling, called or third party).
- Charging of supplementary and value added services.

Generation of CDR (Call Data Records), subscriber billing, trunk billing and automatic backup and format conversion functions should be possible.

Standard interfaces and protocols will be required for sending relevant information to billing centers.

In an NGN environment, it will be important to develop an Interconnection Charge regime that provides certainty to inter-operator settlements and facilitates interconnection agreements. India, for example, currently has adopted cost-based Interconnection Usage Charges (IUCs) which include origination, carriage and termination charges. However, there are at least four possible models for interconnection charges on NGN-based networks. These are: 1. Calling Party Network Pays, 2. Bill and Keep, 3. Charges based on Quality of service, and 4. Bulk billing. The exercise to determine interconnection charges could involve an assessment of the various cost items attributable to different network elements involved in setting up of a call in the NGN environment, or conducted on a barter basis, or by measuring traffic sent (volume, level of QoS provided, etc). Even where the Bill & Keep model is used, some countries may continue the use of carrier charges paid by the originating operator to the access provider. Where interconnection charges are based on network elements, every effort would need to be made to accurately assess relevant network element costs based on the inputs to be provided by various operators. The important issue is to identify the network elements involved in completion of the carriage of a long distance call from its origin to destination in a multi-operator environment.

Migration to NGN would substantially affect the network costs and the relationship between the cost of carrying traffic and distance over which traffic is carried. The similarities between NGNs and the Internet have raised the question of whether the move to NGN will bring the “death of distance” in interconnection charges. Where Internet charges are typically independent of the distance over which data is conveyed, under NGNs the distance related network costs may become much smaller. Therefore, cost based interconnection charges would help in bringing the correct regulatory framework in facilitating faster deployment of NGNs in the market.

Four main basis for Interconnect charges in NGN regime:

In the Internet, some things are known at the level of the application or service, while very different things are known at the level of the network. For VoIP, a server that implements a protocol like SIP will know the time at which a session is initiated, and may know that time at which it ends, but will know next to nothing about the network resources consumed in the interim. The topological location (the logical location within the network) of the originating and terminating end points will be known, but not necessarily the geographical location. Beyond this, an IP-based network will be dealing with a far broader array of applications than just traditional voice. The notion that the call originator should be viewed as the cost causer breaks down in the general case. In the general case, there is no obvious “right answer” to the question of how to allocate costs among end-users. The underlying network knows very different things. In an IP-based environment, each IP datagram is independently addressed, and could in principle be independently routed (although routing in practice is much more stable than this implies). Relatively simple applications can generate a very large number of IP datagrams. For accounting purposes, it is necessary to summarize this data – otherwise, the accounting systems will be deluged with unmanageable data volumes. For analogous

reasons, it is trivial to measure the traffic over a given point-to-point data transmission link, but expensive and cumbersome to develop an overall traffic matrix based on end-to-end traffic destinations.

4.1 Calling Party's Network Pays (CPNP)

CPNP- the network that initiates the call pays for the call, usually based on the duration of the call; generally, the party that receives (terminates) the call pays nothing. In IP based networks, instead of duration of the call, the charging can be based on the number of packets transferred. This can either take the form of Element Based Charging (EBC) or Capacity Based Charging (CBC). Both systems constitute cost-based systems.

Limitations:

- Under EBC the interconnection rates depend on the number of network elements. Implementation of EBC (or CBC) for IP networks would cause transaction costs (e.g. for determining IP points of interconnection).
- Termination Monopoly.

4.2 Bill and Keep

With this regime there are no charges for termination. Basically, Bill & Keep is a kind of barter exchange where network operator *A* terminates traffic from network *B* on its network and vice versa. As traffic flows may balance out in both directions so that there are no payment flows, the price for *A* of getting its traffic terminated on *B's* network consists of *providing network capacities* for terminating traffic coming from *B*. In that sense, interconnection services are not provided for free.

With Bill & Keep, transaction costs can be reduced and there is no termination monopoly problem under Bill & Keep. Without payments for termination services the problem of arbitrage is avoided.

Limitations:

- With Bill and Keep, service providers have an incentive to hand over their traffic to another network for termination as early as possible, giving rise to the "hot potato" phenomenon. To counter this problem, it may be reasonable to make requirements with regard to the minimum number and location of interconnection points for Bill & Keep to be applicable for a specific network operator.

4.3 Based on Quality of Service

If two providers want to compensate one another for carrying their respective delay-sensitive traffic at a preferred Quality of Service, each will want to verify that the other has in fact done what it committed to do.

In the case of QoS, this would seem to imply measurements of (1) the amount of traffic of each class of service exchanged in each direction between the providers; and (2) metrics of the quality of service actually provided. Measuring the QoS is much more complex, both at a technical level and at a business level.

Limitations:

- Commitments between providers would be primarily in terms of the mean and variance of delay. First, it is important to remember that this measurement activity implies a degree of cooperation between network operators which are direct competitors for the same end-user customers. Each operator will be sensitive about revealing the internal performance characteristics of its networks to a competitor. Neither would want the other to reveal any limitations in its network to prospective customers.
- Second, there might be concerns that the measurement servers – operated within one's own network, for the benefit of a competitor – might turn into an operational nightmare, or perhaps a security exposure, within the perimeter of one's own network.

4.4 Bulk Basis (can also be termed as "Interconnect Hotel")

The legacy interconnection charge regime, i.e. per-minute basis, would certainly complicate the smooth settlement of claims. The reason being, NGN products will be based on capacity, quality of service and class

of service. Since the aggregation of traffic would take place at the common node, it is necessary to mandate charging of applicable interconnection charges for NGNs on a bulk-usage basis rather than a per-minute basis prevalent currently. Under NGN, total network costs and carriage would become much smaller relative to traffic volumes and thus average network costs associated with each traffic unit decreases. Charging of interconnect charges on a bulk basis would establish a clear level playing field among the operators and facilitate saving legal costs and time from unwanted litigation and dispute settlement.

In this regard, it is also necessary to identify what should be regulated and what can be left for mutual negotiation.

5. NGN initiative in India

The Indian telecom sector has come a long way from being a government monopoly prior to 1994 to the present scenario of presence of 10 – 11 access providers in each licensed service area. The country is divided into 22 service areas for providing unified access service. A unified access service provider can provide wireline as well as wireless service in a service area. Wireless service includes full mobile, limited mobile and fixed wireless service. The licensee can also provide value added services. Similarly, in the long distance segment presently there are 23 national long distance service providers and 18 international long distance service providers. The status of total access licensees as on 31st March 2008 is as follows:

Summary of Licensees	
Basic Licensees	2
CMTS Licensees	39
UAS Licensees	240
Total Licensees	**281**

The development of new applications, content and converging technologies in India have created an environment where it became necessary to deliberate on the type of future telecom, both in terms of technology and application. Though at present networks are virtually separated to provide fixed telecommunication, mobile telecommunication and internet services; the reducing average revenue per user (ARPU), increasing demand of value added service and convergence are advocating for promoting concept of next generation network.

The telecom operators in India had already initiated their move towards NGN by implementing IP based core network. The migration to NGN is likely to be in stages and may require huge investment by telecom operators. In addition to huge investment there may be regulatory and technological issues which are required to be addressed on priority basis. In order to identify and address various issues related to next generation networks like relevance and timing for transition to NGN and migration related issues, Telecom Regulatory Authority of India (TRAI) took the initiative in July 2005 with an objective of awareness building and released a study paper. A questionnaire was also sent to major operators to obtain their preliminary comments on issues related to NGN. A consultation paper on "Issues pertaining to Next Generation Networks (NGN)" was issued in January 2006. TRAI sent its recommendations on "Issues pertaining to Next Generation Networks (NGN)" to Government in March 2006. The salient features of TRAI's recommendations were:

- Government should arrange to organize some interactive workshops / seminars through its various agencies like Telecommunication Engineering Centre (TEC), Centre for Development of Telematics (C-DOT), and Advanced Level Telecom Training Centre (ALTTC) etc. on various aspects of NGN to bring awareness among different stakeholders.

- It was re-emphasized that TRAI's recommendations for unified licensing regime dated 13th January 2005 should be considered expeditiously so that various operators can make best use of NGN platform to provide all types of voice, data, video and broadcast services through a single license.
- TEC to be entrusted the task to study and analyze various international developments pertaining to NGN in a time bound manner so as to incorporate the same in Indian context and develop interface requirements for the same.
- Cross industry joint consultative group consisting of TEC, Service providers, technical institutions, and vendors etc for analyzing NGN standards & their customization for national requirement to be set up.
- To setup an expert committee having experts from DOT, TEC, C-DOT, service providers, vendors and academicia to deliberate upon various issues related to NGN.
- An expert committee named 'NGN eCO' was constituted on 20th June, 2006 having 30 representatives from various sectors of the Stakeholders. The major tasks entrusted to `NGN- eCO' were:
- NGN awareness building program.
- Timetable for NGN migration in the country.
- Background documents to be used for consultation on Interconnection and QOS issues by TRAI.

NGN-eCO further constituted three core sub-groups having representatives from different stakeholders to study the Licensing, Interconnection and Quality of services (QoS) related issues in detail. Based on the reports of these core groups, NGN eCO submitted its final report to the TRAI on 24th August 2007.

In order to create further awareness about NGN among stakeholders, a one day national seminar was organized by TRAI on "Awareness Building on NGN' on 4th December, 2007 at New Delhi. This seminar was attended by delegates representing service providers, equipment vendors, industry organizations, government departments, PSUs, Academic institutions etc.

TRAI noted that a significant number of telecom operator have begun deployment of NGN. In the transition phase to NGN the existing licensing policy and regulatory framework need to be evaluated with regard to change in technology and market structure. A significant number of telecom operators have begun deployment of NGN. In the transition phase to NGN, the existing licensing policy and regulatory framework need to be evaluated with regard to changing technology and market structure. The NGN concept of "one network – many services" underlines the necessity and explicitly forces a technology-neutral approach with service-agnostic licensing.

The TRAI further noted that migration to NGN could change the existing service providers' business models. On one hand, traditional service providers would see much greater efficiencies and lower costs by adopting NGN and likelihood to provide new services to their subscribers, thus boosting revenues and profitability. The service independence on the other hand could create new category of service providers i.e. application & content service providers, encouraging launch of innovative services and sector specific solutions. This new development will compliment the traditional network service providers with minimal investment and will also facilitate many new services. A possible consequence of such new developments may change service provisioning profile. The traditional network service providers may become pure access providers, and many application services (voice, video, broadband and data, etc.) may be provided by application & content service providers. This could change the business model of the existing operators to an extent, which may require regulatory measures.

It has also been noted that regulators in many developing nations have attempted to lay down broad principles for NGN transition well in advance of the actual transition. This is unlike the legacy network where the business model, network and competition were established prior to regulation. Operators and regulators around the world are deliberating upon how to overcome technical challenges pertaining to interoperability, interconnection and how to encourage infrastructure investment with least possible risk in an open environment of NGN.

Keeping in view all the aspects and given the stage of fast network and infrastructure development in India the TRAI noted that now the time is appropriate to address regulatory and licensing issues related to NGN in

consultation with the stakeholders. The TRAI noted that this will not only help to have a closer look at licensing and regulatory framework, but will also help in reducing investment risk for operators. The TRAI has therefore, issued a consultation paper on "Licensing Issue relating to Next Generation Networks" to seek the comments of stakeholders on various issues. The comments of the service providers have been received. The TRAI is in the process of formulating recommendations on Licensing Issue relating to Next Generation Networks in consultation with stakeholders.

The TRAI is also considering to bring out consultation papers on "NGN Interconnection Issues" and "NGN Quality of Service issues" at appropriate time to help smooth migration to NGN.

6. NGN Environment in South Korea

Interconnection Policy under the Next Generation Networks (NGN) Environment in South Korea is annexed as Annex 2.

7. Conclusion

This report identifies issues and potential challenges to NGN. During the last meeting of Rapporteur's group, it emerged that the Question had been posed to early vis-à-vis the extensive deployment of NGN networks and this situation is likely to continue for some time until NGNs are more widely deployed. A possible solution is that major issues will be identified when more ITU sector members implement NGN in their country and operators interconnect their NGN networks to each other. It was decided to maintain the Question in a revised form in next study period. The transition from PSTN to NGN represents a natural "watershed" event. Interconnection arrangements require massive rethinking at that time in any event. The time of transition to NGN represents an appropriate point at which to reconsider the entire interconnection regime.

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List of Acronyms

NGN	Next Generation Network
ITU	International Telecommunication Union
PSTN	Public Switched Telephone Networks
ISDN	Integrated Services Digital Network
TDM	Time Division Multiplexing
IP	Internet Protocol
SBC	Session Border Controller
IMS	IP Multi-media Service
QoS	Quality of Service
SGW	Signaling Gateway
MGW	Media Gateway
IMS	IP Multi-media Service
IE	Interconnect Exchange
POI	Point of Interconnection
VLANs	Virtual Local Area Networks
VPNs	Virtual Private Networks
CAPEX	Capital Expenditure
OPEX	Operational Expenditure
MPLS	Multi Protocol Level Switching
DNS	Domain Name System
SIP	Session Initiation Protocol
URI	User Resource Identifier
VoIP	Voice over IP
CDR	Call Data Records
CPNP	Calling Party's Network Pays
EBC	Element Based Charging
CBC	Capacity Based Charging
TRAI	Telecom Regulatory Authority of India

ANNEX 1

Presentation on "Next Generation Network (NGN) in Competitive Market Environment" by Warid Telecom International Ltd. (SATRC Workshop on Regulatory Aspects of NGN including Interconnection)

Next Generation Network (NGN) in Competitive Market Environment

Prepared & Presented by Md. Shahriar Rashid, Head of NSS

Warid Telecom International Ltd.
Bangladesh Operations

1

What is NGN?

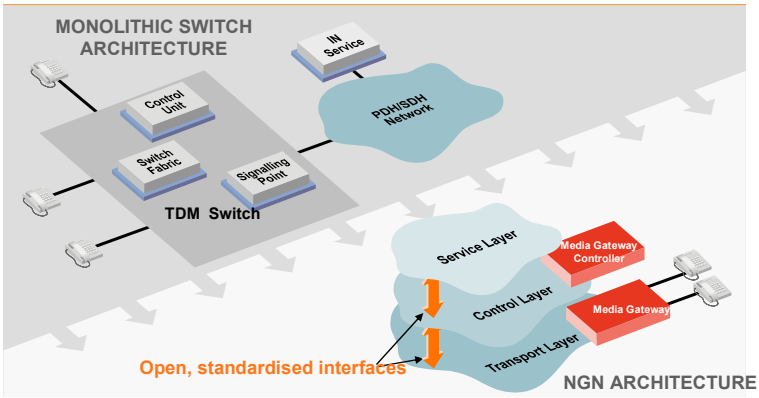
Next Generation Network (NGN)

- Packet-based network.
- Able to provide telecommunication & broadband services.
- Able to support general mobility service.
- Able to support QoS-enabled transport technologies.
- Last but not least , it is a network where service-related functions are independent from underlying transport- related technologies.

2

What NGN Does?

- NGN separates transport layers from control layers.
- Introduce layer architecture.



NGN Next Generation Network

1

Why operator moving towards NGN?

Because of :

Market Situation:

- Continuous volume growth.
- Falling unit prices.
- New service opportunities.

Network Requirements:

- Efficient CAPEX expansion.
- Continuous OPEX reduction.
- IMS preparation.

Cost Optimization & Migration to Common IP Technology.

NGN Next Generation Network

4

NGN Benefits

- "Triple-play" – Voice, Video & Data.
- Simplify service creation environments. -> Easy operation.
- Single network management layer. -> Simplify the operation.
- Services are independent to transport layer. -> Easy deployment.
- Maximize the data network capacity. -> CAPEX savings.
- Open standards creates vendor competition. -> Reduce price.
- Future proof solution for introducing IMS and FMC. -> Ensure TCO.
- Reduce the OPEX and CAPEX.

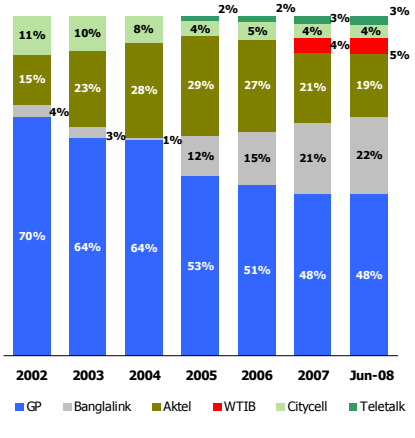
5

Next Generation Network (NGN) deployment in WARID Network

6

WARID is the first operator in Bangladesh deployed NGN Core

Long Term Operator Market Shares (%)



Source: BTRC and WCIS

Operator	Comments
grameenphone	• License: 1996 • Operations: 1997 • Technology: GSM 900 / 1800 • Shareholders: Telenor (62%),Grameen Telecom (38%)
banglalink	• License: 1996 • Operations: 1997 • Technology: GSM 900 / 1800 • Shareholders: Orascom Telecom
AKTEL	• License: 1996 • Operations: 1997 • Technology: GSM 900 / 1800 • Shareholders: Telekom Malaysia International (70%), NTT DoCoMo (30%)
WARID TELECOM BANGLADESH	• License: 2005 • Operations: 2007 • Technology: DCS / GSM 1800 • Shareholders: Dhabi Group
CITYCELL	• License: 1989 • Operations: 1993 • Technology: CDMA 800 • Shareholders: SingTel (45%), Pacific Motors (31%), Fareast Telecom (24%)
TeleTalk	• License: 1996 • Operations: 2005 • Technology: GSM 900 / 1800 • Shareholders: Government

Next Generation Network

7

WARID consideration on NGN selection

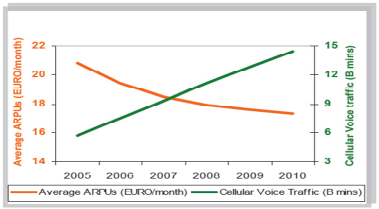
Market Consideration

- ARPU is low.
- 2-3 big players.
- Continuous price cut.
- Continuous new services.
- Fast penetration.
- And fast growth.

Network consideration

- Easy deployment to catch the opportunities.
- Easy operation and maintenance.
- Advanced technology independent on CN and AN.
- Future-oriented network.
- Open system.
- Low cost. TCO.

Global Mobile Traffic vs. Global Mobile Voice ARPU Trends



Source: Alcatel-Lucent Analysis

Mobile Traffic vs. ARPU Trend Characterizes is indicative of Market Dynamics across the Industry and strategically impacts all customer segments (fixed,mobile, enterprise, xVHO, etc) and ecosystems.

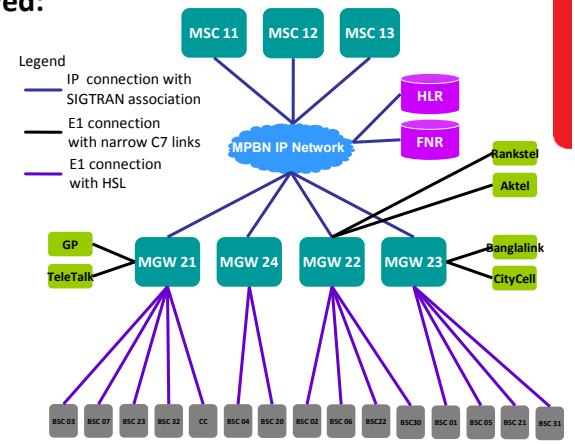
Next Generation Network

8

WARID Core Network

At launch Warid has deployed:

MSC Server	: 09
Media Gateway	: 13
HLR	: 02
FNR	: 02
SGSN	: 01
GGSN	: 01
Core Router:	: 12
Core Switch:	: 12

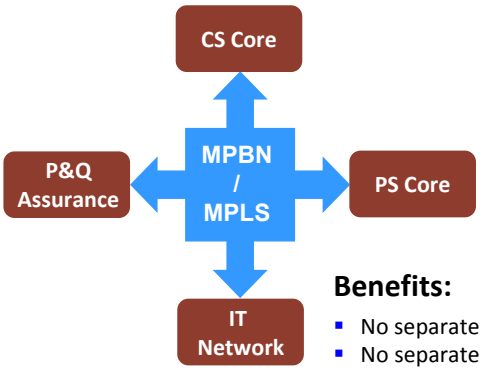


This is happened within 6 to 7 months because of simplified layered (NGN) architecture.

9

WARID IP Backbone

Same transport layer for different services



Same IP backbone used for:

- Circuit switch voice traffic.
- Circuit switch signaling traffic.
- GPRS network/service.
- IT network.
- Performance & quality network.
- IP phone (for Warid office only).

Benefits:

- No separate investment for IT and GPRS network.
- No separate investment for transmission of Warid office internal calls.
- Optimize bandwidth utilization for Warid to Warid calls by payload traffic (Nb Traffic).
- CAPEX and OPEX savings.

10

Transmission Efficieny in Traditional Network

Example: Legacy/Traditional Local Switching

- Call under same BSC has to carry over to MSC by costly TDM based transmission. 2 long distance circuit is required for per intra BSC calls.
- Call under same area PSTN/PLMN has to carry over to MSC by costly TDM based transmission.

Result: High CAPEX Involvement, Lower optimize usages.

NGN Next Generation Network

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Transmission Efficieny in NGN Network

Example: NGN Local Switching

- Call under same BSC does not need to carry over to MSC. Saving 2 long distance circuit for per intra BSC calls.
- Call under same area PSTN/PLMN does not need to carry over to MSC.

Benefits: CAPEX saving, CAPEX maximization

NGN Next Generation Network

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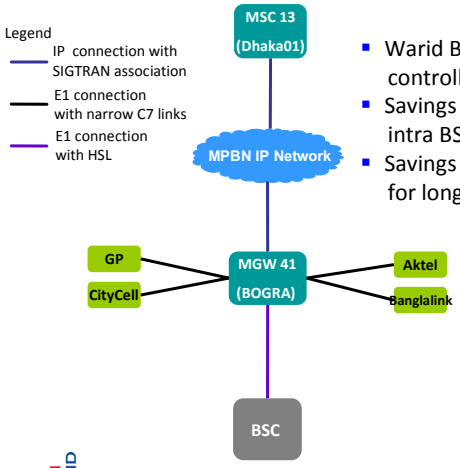
Transmission Efficieny in Warid Network



Distance between Dhaka and Bogra is 300KM.

- Warid Bogra BSC connected with Bogra MGW controlling from Dhaka MSC-S.
- Savings transmission bandwidth and cost for intra BSC/MGW calls.
- Savings 66% transmission bandwidth and cost for long distance calls.

Benefits:

- CAPEX saving.
- CAPEX maximization.
- Bandwidth utilization.

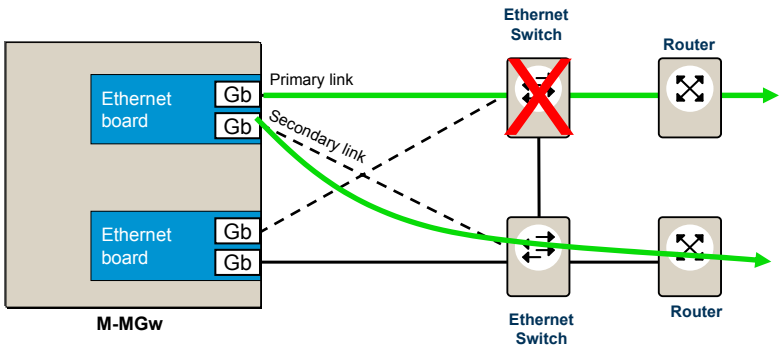
Next Generation Network

13

IP Backbone Redundancy in NGN Network

As all service are providing through same IP backbone,

Backbone Redundancy is High Priority.



Benefits: High availability & increased robustness.

Next Generation Network

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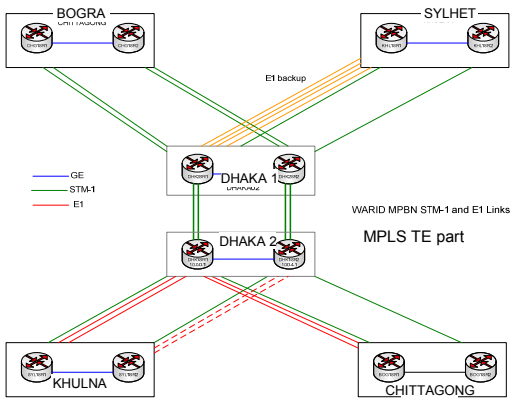
IP Backbone Redundancy in Warid Network



Warid has deployed:

- 1+1 Redundant MPBN.
- Signaling redundancy by E1 Sylhet, Bogra and Khulna incase of fiber cut for MPBN.
- Router to Router is GE.
- Board level Ethernet card redundancy at MGW level.

Benefits:

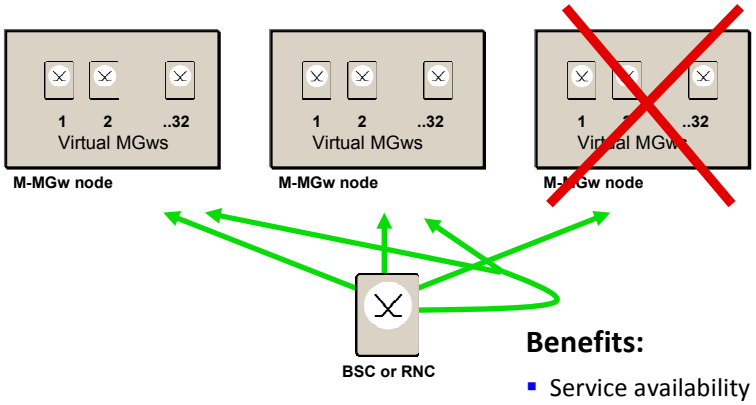
- Service availability high.
- Day time maintenance.
- No single point of failure.
- Reduce O&M cost.

Next Generation Network

15

BSC Load Sharing in Warid Network

Advantage of Soft Switch with virtual MGw



Benefits:

- Service availability high.
- Day time maintenance.
- No single point of failure.
- Reduce O&M cost.

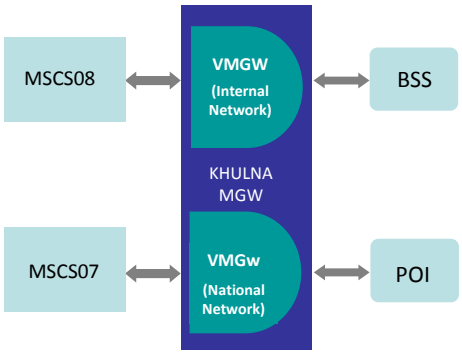
Next Generation Network

16

Core Capacity Optimization in Warid Network

Advantage of separate control and connectivity layer

Distance between Dhaka and Khulna is 300KM.



- Khulna MGW is controlling by 2 MSC-S from Dhaka.
- BSC is controlling by one MSC-S.
- POI is controlling by another MSC-S.

Benefits:

- Utilization of MSC-S's extra capacity.
- Resource utilization.
- Service/capacity ensure during festivals like EID.
- CAPEX maximization.

NGN Next Generation Network

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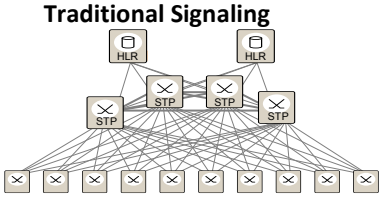
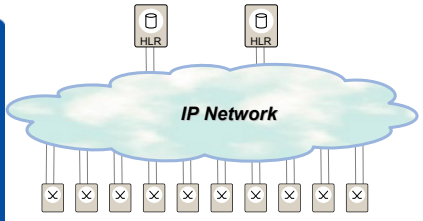
Signaling Architecture in Warid Network

Traditional Signaling



Signaling over IP



- Traditional signaling has complex physical & logical configuration.
- Signaling over IP (Sigtran) has simple configuration (IP address only).
- Warid HLR and FNR are based on Sigtran.
- Warid MSC-S to MSC-S is through Sigtran.
- Warid IN SCP and SDP are based on Sigtran.
- Like other operator Warid does not require separate STP or Signaling Gateway (SG).

Benefits:

- CAPEX saving, no investment for STP & SG.
- Better utilization for transmission capacity.
- Packet switch and O&M traffic can be shared from signaling transmission.
- Less analysis require for signaling.
- Easy O&M means reduce OPEX.

NGN Next Generation Network

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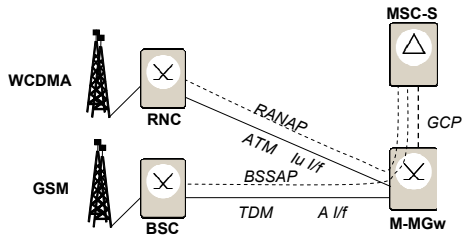
Warid way forward:- 3G network deployment

NGN allows simultaneous access for WCDMA & GSM



- Warid has no traditional MSC.
- Warid has soft switch MSC.
- Warid has IP backbone.
- No investment require in the core network.

Warid core network is ready for 3G deployment. No architectural change is required.

Benefits:

- Flexible use of investment.
- Ensure TCO.

Requirements:

- 3G license from regulator.
- RNC, Iu over IP.
- NodeB, Iub over ATM.

NGN Next Generation Network

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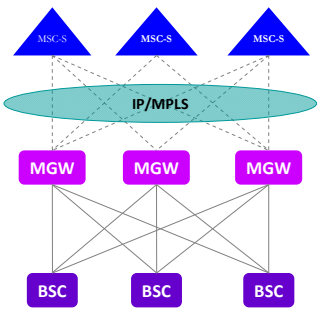
Warid way forward:- MSC in Pool deployment

Defined in 3GPP R4



Advantage of MSC in pool:

- No inter MSC handover is required within the pool area.
- No call drop due to inter MSC handover.
- No LU is required within pool area.
- Traffic balancing, specially during special event like EID, HSC, SSC result, 31st nights.
- Service availability.

Benefits:

- Service availability high.
- Day time maintenance.
- No single point of failure.
- Reduce O&M cost.
- Utilization of MSC-S's extra capacity.

NGN Next Generation Network

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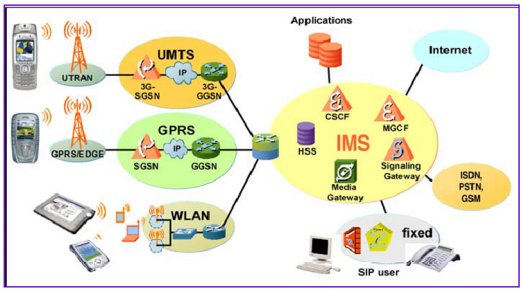
Warid way forward:- IMS deployment

Defined in 3GPP R5

- One of the requirement for IMS is service independent transport layer.
- Warid existing MPBN transport (IP) layer is service independent.



Benefits:

- Time-to-market will be reduced.
- Commercialized services growth will be Cost-effective.
- Ensure TCO.

Next Generation Network

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Nutshell

NGN helps WARID (a green field operator)

- Faster network deployment.
- Maximize utilization the CAPEX.
- Reduce the OPEX.
- Higher availability.
- Participate in the Air time price cut environment.
- Ensure TCO.
- Ready for 3G and IMS.

Next Generation Network

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ANNEX 2

Interconnection Policy under the Next Generation Networks(NGN) Environment in South Korea

Next Generation Network (NGN) environment

A Next Generation Networks (NGN) is a packet-based network able to provide telecommunication services to users and able to make use of multiple broadband, Quality of Services (QoS)-enabled transport technologies and in which service-related functions are independent of the underlying transport-related technologies. It enables unfettered access for users to networks and to competing service providers and services of their choice. It supports generalized mobility which will allow consistent and ubiquitous provision of services to users. [ITU-T Recommendation Y.2001 (12/2004) - General overview of NGN]

As network environment moves from circuit-based to packet-based, telecom regulators in most countries need to review whether current policy fit the packet-based environment and promote network development. Among several telecom policy issues, interconnection policy has a major position among issues of telecom policy.

Interconnection policy

Through the interconnected networks, individuals are able to communicate with others who are not in connection directly on their network. That is, if an individual subscriber is connected to a particular network through interconnection, the subscriber can communicate with anyone who is connected to many other networks that are connected with the particular one. Given this, effects which the subscriber can gain through network will increase, as the number of subscribers connected through the interconnection grows. Adding up all of these effects will increase exponentially and this is called network effects.

As the telecommunications market turns over into competitive environments by multi-carriers, government's policy regarding network connection between carriers plays an important role in its competitive policies. While interconnection policy provides incentives for new entrants to do business, it provides investment incentives for the current vendors that own and operate networks. ITU's recommendation for interconnection policy is that the connections between networks should be provided in a timely manner, and the charges should be based on cost-oriented rates. The organization also recommends that the price needs to be set in a transparent, reasonable, and unbundled way (ITU Reference Paper, Para. 2.2(b)).

The key issues regarding interconnection policy include the process of connection request and offer, the assessment procedure of charge, the conditions of level, technology and operation of charge.

Roles of regulator in terms of interconnection

Regarding the government's role of regulating interconnection, there is a need to identify the existing as well as new regulations for the entrants to the interconnection market. Government needs to prepare an interconnection guideline in order to let new entrants know about technical and operational issues on interconnection with other carriers. Generally, in the guideline, definitions of types of interconnection, descriptions on carrier-to-carrier relationship, declaration of carrier-to-carrier charging principles, and accounting principles among carriers are included.

When assessing charges through negotiation between carriers, it can cause conflicts. Right then, it is a high time the government should intervene in the negotiation between carriers. Basically, charges refer to the fees paid for the rent to use other carriers' networks. To some of new entrants, the charges take up to 40~50% of the total cost, making a direct and significant effect on the carriers' outcome.

Interconnection issues under the NGN environment

There are three different types of interconnection models: The interconnection in Public Switched Telephone Network (PSTN) which is the base of telecommunication services; the interconnection in Voice over Internet

Protocol (VoIP) which is spreading out recently; and the interconnection in All-IP which is expected to work as the based for the future telecom networks.

In VoIP which is based on the Internet packet system, vendor using access is hard to prescribe the network component of vendor which is providing. In other words, theoretically, delivery path depends on packets, so it is hard to figure out the network components of each vendor properly. As such, it is tough to apply the estimation system to the existing PSTN. Suggested model until now is a charge system which is applied to the data communication systems including the Internet. It is "Uniform Access Charges" which pay charges regardless of the distance and type.

Table 1. Comparison of Telecommunications and Internet Cost Recovery

Telecommunications	Internet
• Cost recovery subject to significant regulation and government oversight. • Settlements are transparency. • Settlements based on traffic flow and charged on minutes of use. • "Half-circuit" approach to sharing the costs of the international link. • Settlements operate on a destination specific basis. • Under the accounting rate settlement model, the same system applies for all network operators.	• Little or no regulatory oversight. • ISP contracts are subject to non-disclosure agreements. • ISPs combine transmission and content. • Cost recovery based on link capacity. • Charged on bandwidth and derived throughput of the link. • ISP network access provides onward transit to many other networks and destinations. • ISPs use different charging models, depending on the characteristics of the ISPs involved.

Regarding models of internet interconnection, there are two agreement schemes which are peering agreements and transit agreements. Peering agreements, which is so called "Sender Keep All" or "Bill and Keep," is a zero compensation arrangements by which two internet service providers (ISPs) agree to exchange traffic at no charge. The process, terms, and conditions remain private. Transit is an agreement in which larger ISPs sell access to their networks, their customers, and other ISP networks with which they had negotiated access agreements. The sender pays the full cost of interconnection. Transit charges are set by commercial negotiation, and are generally not disclosed. One Internet transit payment arrangement with one major Tier-1 ISP can provide a small, remote session initiation protocol (SIP) with access to the rest of the world.

The opportunities VoIP creates for arbitrage create pressures to move toward cost-based pricing for interconnection and adopt uniform charges for access, regardless of the type of call, type of service providers, or other call characteristics. New approach to interconnection pricing should encourage efficient competition and the efficient use of, and investment in, telecommunications networks, preserve the financial viability of universal service mechanisms, treat technologies and competitors neutrally, allow innovation, and minimize regulatory intervention and enforcement.

In the meantime, we forecast that the environment of information communication network will be turned into All-IP type in the future. In this case, relationship between service and cost driver will be ambiguous to prescribe as interconnection is developing to convergence service. Accordingly, new charge estimation system will be requested. As the network environment is developed, the converged IP network based network will be emerged as a popular alternative, providing diverse services through a single backbone network. Here, it should be kept in mind a new charge scheme will become one of the challenges.

Transition on Interconnection policy in South Korea

A monopoly telecom operator, Korea Telecom (KT), was founded in 1982 when there was no interconnection issue due to monopoly. In 1984, Korea Data Telecommunication launched data communication services and there was no interconnection charge for dial-up calls. Spun off from KT, Korea Mobile Telecommunications (KMT) provided analog mobile service in 1988. Interconnection charges and conditions were left to operators' negotiations.

Since Dacom launched international call service in 1991, Interconnection Order was released. The Order declared reciprocal compensation that calling party pays interconnection charge to called party, focused on non-discriminatory interconnection, and did not require accounting separation. Accounting Separation Order was published in 1994. In the Order, it is requested that cost separation of NTS and TS from 1996. In the mid-1990s, several telecom service providers entered the telecom market in Korea. Regarding interconnection, mother network system is applied. For both fixed-to-mobile and mobile-to-fixed calls, mobile operators collect tariffs and paid fixed network's interconnection charges to fixed operator. When interconnecting with local network, the other party paid for the interconnection line. It is required that KT's local switched provides for interconnection to any telecom service providers.

After WTO agreements settled in 1997, which agrees to open telecom market to operators without network, interconnection scheme was back to reciprocal compensation and set interconnection charges at dominant carriers' cost, and abolished NTS deficit contribution and introduced NTS interconnection charges. As Hanaro telecom (now SK Broadband) started local telephony and broadband services in 1999, interconnection between local networks was imposed. It was also determined that cost-based mobile networks' interconnection charges, interconnection line cost borne by user network, and universal service fund introduced.

In 2001 KT's local tariffs was rebalanced. A plan for abolishing NTS interconnection charge for five years was announced in 2001 when long-distance carriers were exempted. Individual interconnection charges for mobile networks for 2002-2003 were determined. Mobile internet facility was opened to mobile ISPs and portals.

Research on Long-run incremental cost (LRIC) started in 2003 and applied from 2004. As data communication services were flourishing, interconnection between data networks was applied. In 2007 through a review process of interconnection charges for 2008 and 2009, different mobile termination charges between dominant and non-dominant carriers was applied.

Interconnection charge scheme of VoIP in South Korea

Even though a dial-pad service based on soft-phone was launched by Saerom in 2000 in South Korea, in substance commercial services started on May 2004 when a guideline of internet telephony was announced. Since October 2004 internet telephony has been common telecom services under regulation and "070" service identification number was assigned to internet telephony services. After expansion of number portability to VoIP services, number of subscribers of VoIP will be expected to increase dramatically.

In terms of interconnection, unbalanced approach is applied. For VoIP calls to fixed or mobile network, VoIP service providers pay the same amount of interconnection charge as circuit-based network to fixed or mobile carriers. Among VoIP service providers, there is no settlement of interconnection charges. In case of calls from fixed or mobile to VoIP users, fixed or mobile operators also pay interconnection charge to VoIP service provider. The fee takes network component of VoIP service providers toward an access to the network into account.

Table 2. Interconnection charge for VoIP in South Korea

Interconnection type	Interconnection charge
VoIP to fixed	VoIP service provider pays the same amount of interconnection fee to fixed operator.
VoIP to mobile	VoIP service provider pays the same amount of interconnection fee to mobile operator.
VoIP to VoIP	No settlement
Fixed or mobile to VoIP	Fixed or mobile operator pays interconnection fee to VoIP service provider. The fee accounts for network component which required to access network.

Current solution for VoIP interconnection charges in South Korea is still a tentative one. As VoIP service diffuses, unbalanced approach for interconnection charge could be a debatable issue. In the long-run, interconnection under the All IP network should be considered. Transition path or scheme also should be come up with. In this process, traditional principles on the objectives of telecom policy – users' benefit, fair competition, network advancement, and technology development – should be taken into account.

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